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ABSTRACT

Four programed instruction courses were developed in the form of printed texts. They covered the California Penal Code, the laws of arrest, search and seizure, evidence, and dangerous weapons control laws. The programed courses were used as self-study instructional material for recruit training and for in-service training for policemen. The courses proved to be effective and economical. The presentation of the programed lessons at a computer terminal was evaluated and found to be equally effective as the printed material. However, the computer was found to be less efficient in terms of student time and to be more costly than the workbook format. (JY)

ED 058724

FINAL REPORT

June 30, 1971

Development and Evaluation of

COMPUTER ASSISTED/PROGRAMMED INSTRUCTION ON THE LAW

Prepared for
State of California
California Council on Criminal Justice
1108 - 14th Street
Sacramento, California 95814

Attention:

Robert H. Larson
Executive Director

Sponsored under

CCCJ Grant, #0195 Dated May 1970

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1. SUMMARY

1.1 Results

The following results were achieved in Project 0195, Computer Assisted/Programmed Instruction on the Law.

1.1.1. Four programmed instruction (PI) courses were developed in the form of printed texts covering the following subjects: The California Penal Code; The Laws of Arrest, Search and Seizure; Evidence; and Dangerous Weapons Control Laws. These texts are appended as part of this report.

1.1.2. The self-study PI texts were used as a regular part of recruit academy courses for both home study and as a primary activity during supervised study hall periods in class. The self-study materials, which replaced formal lectures as the primary instructional format, were found to be effective and efficient in reaching training goals, in reducing overall study time, in streamlining scheduling of the recruit academy, in reducing instructor work load, and in increasing the instructor time available for attention to the individual learning problems of students. Two experienced officers, each of whom lacked prior formal training as teachers, were able to present the courses on criminal law (Penal Code) and on the laws of arrest, search and seizure with minimal preparation. Student achievement was as high as in previous recruit schools. Anecdotal evidence indicates that student achievement was actually improved, but no data could be obtained to verify this statistically.

An opinion questionnaire, completed by the recruits, showed that 97% felt the materials were effective in reaching course objectives and 71% preferred PI texts to other forms of instruction which they had in the academy. 85% expressed a desire to have programmed instruction in additional subjects.

1.1.3. A limited sample suggests that the self-study materials are effective in reducing the academic failure rate, particularly of recruits with poor academic backgrounds and skills. In the past, such recruits have had particular difficulty with the course on the Penal Code. In the 62nd Recruit School, two recruits were dismissed for academic failure. They had passing scores of 72% and 78% on the Penal Code final examination, and failed because of grades below 70% in courses taught by conventional means.

1.1.4. The PI lessons on the Penal Code were used in a pilot in-service training program. Each member of the 450 man Patrol Division was given a lesson per week and allotted fifteen minutes of each regular, daily, 30 minute roll call period for individual study.

1.1.4.1 An opinion poll was devised by the Oakland Police Department to evaluate the response of experienced officers to this form of in-service training. 91% indicated that they felt their knowledge had improved. 78% of the responding officers indicated a preference for programmed instruction over the lecture format which typified previous training programs. 58% of the officers voluntarily worked on the materials on their own time despite the fact that they were not to be tested on the materials or held accountable for them in any way. 54% of the officers expressed a desire for more on-duty time to study the materials. 77% thought the level of the Penal Code course was satisfactory, even though it was designed specifically to meet the needs of inexperienced officers. It is expected that the course on the laws of arrest, search and seizure will be even more suitable for this type of in-service training of experienced officers.

1.1.4.2 A small control group of experienced officers was given pre-tests and post-tests in conjunction with the PI materials. The group as a whole showed a 19% improvement in test scores. The ease and economy of providing training by means of programmed instruction coupled with the major improvement in student acceptance of this program over earlier lineup and in-service training programs suggest that the method is useful for training experienced officers.

1.1.5 The PI lessons on the Penal Code were used successfully for the training of civilian dispatchers employed by the Oakland Police Department. The Commander of Communications Section in which the dispatchers are employed found the training to be effective and convenient and to be of significant help to the dispatcher in their work.

1.1.6 The presentation of PI lessons at a computer terminal was evaluated and found to be equally effective as the printed material. However, the computer was found to be less efficient in terms of student time and to be more costly than the workbook format. Computer presentation of instruction was workable and favorably impressed students but does not appear to be economical or advantageous.

1.1.7 A diagnostic test on homicide laws was administered at a computer terminal. The computer analyzed the results and returned to the student a study prescription keyed to the PI materials. The method satisfactorily identified student needs but offered no advantages over written tests sufficient to justify the costs for continued use.

1.1.8 Analyses of the development and use costs of PI materials and of computer presentation of instruction were made and are included in this report.

1.1.9 The PI materials on the law have been adopted for continuing use by the Oakland Police Department. Presentation of the materials and methods developed in this project will be a major portion of the program of the third annual Institute on Teaching Law to the Police Officer at the University of California at Davis in August, 1971. Articles on the results of the program are in preparation by the project personnel and will be submitted to appropriate journals for publication.

1.2 Conclusions and Recommendations

The results of this project support the following conclusions:

1.2.1 Programmed, self-study instructional materials can and should be used for recruit training and in-service training in the police training environment to achieve higher levels of proficiency in less time, to reduce scheduling problems of both students and instructors, and to reduce instructor preparation time.

1.2.2 Computer presentation of programmed instruction material on legal subjects is more costly and somewhat less efficient than printed presentation of the same programmed material. These disadvantages appear to outweigh the motivational novelty, the automatic record keeping, and the ease of updating which are advantages of computer-assisted instruction.

1.2.3 The instructional materials developed under this project are ready to use and can be adopted immediately by any law enforcement agency in California. These materials permit the individualization of classroom instruction without changing teacher-student ratios. The materials permit the student to proceed at his own pace, they contain intermittent testing which identifies student needs and evaluates progress during the learning process, and they free the instructor to work with students who have special needs, interests, or problems. Detailed instructions and suggestions for use of these materials for recruit and for in-service training are given in Section 2.2 of this report.

1.2.4 The programmed instruction courses developed under this project are appropriate to the training needs of many civilian employees of police agencies. Jailers and dispatchers are typically most in need of such training. Because of the economy of packaged PI materials and the ease of scheduling packaged instruction on an individual basis, the materials create a means to provide training which has often been denied in the past.

1.2.5 There exists a need for professionally developed, individualized training materials emphasizing active student responses in the areas of report writing, criminal investigation, and patrol procedures. Such materials would be different in form

but similar in educational concepts to the materials developed under this program. A grant application for the development of such individualized and packaged training courses is being prepared by the Oakland Police Department for submission to the California Council on Criminal Justice.

1.2.6 The following two letters discussing the results of use of the PI texts developed under this project are from the Commanders of the Training Division and the Records and Communications Division of the Oakland Police Department.

CITY OF OAKLAND

POLICE ADMINISTRATION BUILDING • 455-7TH STREET • OAKLAND, CALIFORNIA 94607

Police Department

July 12, 1971

American Analysis Corporation
420 Market Street
San Francisco, California

Attention: Dr. Peter Lenn

Dear Dr. Lenn:

We have completed tabulating preliminary returns of the questionnaire which was issued to all personnel who participated in the recent Penal Code programmed instruction course. The following information, although not complete, will perhaps serve as a barometer of the efficacy of this type of training for police officers.

Although 450 personnel participated in the course, only 141 questionnaires have thus far been returned. This is attributable to two factors; (1) no control on questionnaire return was implemented via signatures, checkoff lists, etc., in order to obtain the most impartial information, and (2) random questioning of groups of personnel who participated in the program as to the relatively small return indicates a substantial number of personnel had not completed the programmed workbooks and did not wish to fill out the questionnaire until they had done so. This latter factor, in my opinion, is important and is discussed more fully below.

Of the 141 questionnaires received, a high percentage (78%) indicated a preference for programmed instruction over the lecture format previously employed. Most of the officers who responded (77%) indicated that they thought the teaching level of the material was satisfactory, even though the course was originally designed for recruit officers. This is significant and indicates that performance objectives of the course were realistically designed around understanding of on-the-street situations. More than half (54%) of the respondents indicated a preference for more time to complete the workbooks than was provided during line-up training sessions.

A factor which is significant by itself and which reaffirms the rationale for not completing the questionnaires is the relatively high number of persons (58%) who indicated that they devoted additional hours of off-duty study towards completion of the programmed workbooks. The workbooks were completed by officers in recruit school during a total time allocation of 26 hours and, in retrospect, I feel that it was generally an impossible task put upon personnel to complete the workbooks

as line-up training in only nine hours of fifteen-minute training periods, which time was fraught with interruptions. However, it is particularly impressive to me that personnel voluntarily devoted substantial amounts of their off-duty hours to complete the workbooks, with no benefit to them except a greater knowledge of the Penal Code. This would seem to demonstrate two things; (1) a strong desire on the part of line personnel for in-service training and (2) a reaffirmation in my mind of the minute-by-minute "challenge to continue" this kind of instruction, based on its unique teaching method.

Ninety-one percent (91%) of the personnel who returned questionnaires indicated that their knowledge of the Penal Code improved as a result of their participation in the programmed instruction course.

Lastly, it is interesting to note the suggestions for additional subject material which were made in the questionnaire returns, especially since a substantial number of persons indicated a wish for instructional material in Search and Seizure (a course which was also designed under your project grant). Other subjects suggested were Patrol Procedures and Report Writing.

In summary, the responses to the questionnaire indicated a high degree of acceptance and effectiveness of the program and a desire for additional subjects by this teaching technique. I hope that you will find the questionnaire results gratifying and you may be assured that I find them indicative of the quality and versatility of the product which you have prepared.

Sincerely,

J. McArthur
Lieutenant of Police
Training Division

CITY OF OAKLAND

POLICE ADMINISTRATION BUILDING • 455-7TH STREET • OAKLAND, CALIFORNIA 94607

Police Department

July 2, 1971

Mr. Peter D. Lenn, President
American Analysis Corporation
420 Market Street
San Francisco, California 94111

Dear Mr. Lenn:

I feel I should convey my impression of the programmed instruction on the California Penal Code prepared by your firm. When it was first presented to my Communications Dispatchers in April of this year, it was my first opportunity to observe its effects.

Few of the employees had prior knowledge of the subject but they seem to have gotten more lasting information from this course than any other. All comments made were favorable and those taking this course preferred this method over lecturing.

Since the dispatchers have been working in the Radio Room, they have had fewer problems with the Penal Code than in any other area. In my opinion, the programmed instruction provided by your firm is both convenient and effective.

Sincerely yours,

A. M. Long
Lieutenant of Police
Records & Communications
Division

AML:je

DESCRIPTION AND DISCUSSION OF PROJECT

2.1 Programmed Instruction Materials Development

2.1.1 Concepts of Programmed Instruction

The methods of programmed instruction are based upon the following concepts:

1. The curriculum is designed to achieve specific educational objectives which are formulated in terms of operational competence of the student.

2. Instructional materials are planned for individual use thereby permitting scheduling flexibility and self-paced progress by the student.

3. Immediate re-enforcement of learning by requiring its application in question and answer situations, problem solving or case study.

4. Refinement of instruction materials through extensive trial on sutdents until the curriculum in fact meets the educational objectives.

2.1.2 Instructional Objectives

The objectives listed below were established to guide the current development of instructional materials on the law related aspects of the California Penal Code, investigation, arrest, evidence, search and seizure and the administration of justice. Other training experiences, including outside reading, lectures, role playing and supervised field assignments will lead to the attainment of additional objectives of police training and will contribute to the attainment of the following objectives.

At the conclusion of the course, the recruit will:

1. be able to identify the roles and describe the operating procedures of the governmental bodies involved in law enforcement, criminal justice and the maintenance of order.

2. (a) be able to identify the elements of a crime as presented in a fact situation and be able to list the elements that must be present to establish the commission of a crime.

(b) be able to classify crimes as felonies and/or misdemeanors.

(c) be able to consult the penal code to identify uncommon crimes and their elements or to clarify any point of procedure.

(d) be able to apply the procedural sections of the penal code as a basis for police action in case study situations.

3. be able to decide in case studies when to detain, arrest, cite, warn or seek a warrant for arrest, and be able to discuss the basis for such decisions.

4. be able to choose reasonable courses of action and appropriate levels of force in case studies or dramatized situations, having taken into consideration laws, ordinances, policies and procedures.

5. (a) be able to identify proper and improper searches and seizures from case studies.

(b) be able to identify situations in which search warrants should be sought from those in which a valid search may be made without a warrant.

6. be able to write reports in conformance with departmental instructions.

7. be able to testify properly in court.

8. be able to read independently and to apply information in departmental training bulletins.

9. be able to answer questions of law such as might arise in explaining his actions and informing citizens of their rights and obligations under the law.

10. be able to distinguish situations in which the patrolman has the legal and/or departmental authorization to exercise his own discretion. The cultivation of good judgement is an overall objective that cannot be attained only by the materials being developed in this project. Other training approaches including lectures, reading, role playing and field training will be used concurrently and will be directed at development of good judgement.

On the basis of these general objectives, specific objectives were formulated for each portion of the course. These objectives are described in each of the four courses, so that the students and their instructors can determine what is to be learned and whether it has in fact been learned.

In the case of the course on the Laws of Arrest, Search and Seizure and the course on Evidence, the specific objectives were originally formulated as a set of test questions covering all the skills to be taught. These "Criterion Tests" appear as the last section of the text on the Laws of Arrest, Search and Seizure and in the form of "Progress Check" tests at the end of each of the four lessons of the Evidence text. For the Penal Code and Dangerous Weapons courses, the objectives were originally in narrative form and the criterion tests were developed subsequently. The narrative objectives used to design the Dangerous Weapons course are included below to illustrate the form of the narrative objectives and to permit comparison between these objectives and the Criterion Test at the end of that course.

OBJECTIVES - Dangerous Weapon Control Laws

At the completion of this lesson the student will be able to perform the following tasks:

1. Determine whether a potentially dangerous implement is a dangerous weapon according to the California Penal Code.

2. Classify dangerous weapons according to type.

3. Identify those weapons, the mere possession of which is unlawful.

S. 12020	a.	blackjacks, slungshot, billy, sandclub, sandbag, metal knuckles
S. 12420	b.	teargas weapons
S. 12020	c.	sawed-off rifles, sawed-off shotguns
S. 12220	d.	machine guns

4. Identify those weapons which are unlawful to be concealed on the person or in a vehicle.

S. 12025	a.	handguns, concealable firearms (without a license)
S. 2006 F&G	b.	rifles or shotguns with cartridge in chamber
S. 653k	c.	switchblade over 2" in blade length

5. S. 12031 Identify those special situations in which it is a misdemeanor to carry loaded firearm.

6. S. 171c Identify those special situations in which it is a felony to carry loaded firearms (Mulford Act)

7. Identify the classes of persons whose privilege to bear firearms is specially restricted.

S. 12021	a.	any person who is not a citizen
"	b.	any person who has been convicted of a felony
"	c.	any person who is addicted to the use of a dangerous drug
S. 12021.5	d.	minors lacking parental consent

8. Identify unlawful explosive devices as defined by the Penal Code

9. S. 12022 Recognize the occurrence of a separate punishable offense during the commission of a felony while armed with a concealable weapon.

10a. S. 12027 Consult the Penal Code to identify the following exceptions to weapon control laws.

a. clubs and organizations who use target ranges, transportation to and from.
b. clubs, which collect and display guns, antiques, etc.
c. clubs, civil and military organizations, while parading, transportation to and from.

11. Identify crimes involving tampering with serial marks on firearms.

S. 12090	a. tampering with serial number
S. 12093	b. falsifying identification number
S. 12094	c. purchase or sale of weapon lacking identifying number

12. Determine whether violations of weapons control laws are misdemeanors or felonies.

2.1.3 Developmental Testing

All of the instructional materials prepared were subjected to repeated cycles of trial usage by typical students followed by revision. This testing process is accomplished by having the student work through a course without help while being observed by an educational technologist. The observer notes any incorrect responses and the student's reaction upon comparing his response to the correct response.

To observe a student working on PI materials is a fascinating experience for an educator. One immediately observes that the student is motivated by his success in making correct responses. When a student makes a wrong response, whether it was due to his own carelessness or to a defect in the materials, he loses enthusiasm and concentration. In order to obtain an accurate evaluation of the materials, the observer must avoid tutoring the student on the material before it has been presented in the PI text. On the other hand, it is necessary to assist the student over weak points in the materials. In this way the entire course can be tested without interference by correctable deficiencies.

The function of testing of programmed instruction materials is to determine their educational shortcomings. Each lesson is intended to enable the student to acquire demonstratable behavior which he was unable to exhibit before taking the lesson. Behavioral goals can range from an ability to spell "corpus delicti" to being able to determine from a case history what crime, if any, has occurred. Testing with typical students provides an indication of which training goals have been met, which were simply not met, and where the student has been trained to behave in an incorrect or undesired manner. Initial testing with one or two students is sufficient to determine major shortcomings. Later, after several cycles of testing and revision, it is necessary to test the materials on a larger number of students to "validate" the fact that the materials do enable the entire target population to reach the training objectives.

Testing of the programmed instruction materials also provides the data necessary to develop efficient lessons. By determining those places in the lessons where students become confused or respond incorrectly, it is possible to repair these shortcomings, so that later students will not encounter difficulty and will therefore be able to learn more quickly. It is an important

concept of education that the learning process not be considered a test. One may test before the lessons begin to select students and after the lessons have ended to determine whether the students can do those tasks for which they have been trained. But, during the lessons, a student's learning is facilitated by active participation in the lessons, by continuous success and by lack of confusion.

Programmed instruction lessons are designed to take advantage of these concepts of promoting efficient learning. The lessons require the student to respond actively at each step of the way. It is the responding that is important to learning, not the fact that there is a possibility that the student may make an incorrect response. Therefore, it is a goal in the development of programmed instruction materials that all the students make correct responses to all the questions in each lesson. Though every student will respond incorrectly occasionally, and some students may make a large number of incorrect responses, the testing process enables us to develop PI lessons that minimize student confusion and provide him with the motivation that comes from succeeding in his task of learning. A student learns faster if he can be led to making the right response to every problem presented to him.

Unlike conventional texts and lectures, the burden of success or failure is assumed to be the responsibility of the programmed materials. During the testing and revision process, what appears to be student failure identifies flaws in the materials under development. The result is an instructional package in which student success in terms of predefined educational objectives is predictable for target student populations.

2.1.4 Validation Testing

The purpose of validation testing is to determine whether the PI materials are actually successful in enabling all of the students to achieve the educational objectives. Of the four courses developed, the Penal Code text was most extensively tested and the course on Laws of Arrest, Search and Seizure was used with one full recruit class. Though the Evidence and Dangerous Weapons texts were subjected to trial usage during development, neither has received sufficient use to be considered validated. However, these materials will be used in forthcoming recruit academies and it is expected that the results achieved will validate those courses.

2.1.4.1 First Validation Text of Penal Code Materials

In this first Validation Test of the Penal Code text, the students were given 8 days to cover the material. During this time they had five 3-hour study hall periods in which they could work or not, as they chose. In the study hall periods, they had access to a proctor who was able to answer questions and discuss the subject matter knowledgeably. Most students spent the study hall hours rather at leisure and did the bulk of their studying at home. After the first day, student questions were concentrated in the first hour of each day's study hall period. This leads to the conclusion that the study hall periods could be shortened to a daily 1-hour discussion period, during which the problems which the students encounter in their home study could be covered. On the last of the 8 days allowed for studying the PI materials, the students had a 3-hour lecture/discussion session with the Penal Code instructor. The following day they were given the same final examination on the Penal Code that had been used in the recruit academy of the previous summer (but omitting the last four questions on the laws of arrest). A copy of that examination is included in the Appendix of this report. A comparison of the results obtained in the previous administration of this test to students who had been given traditional instruction with those obtained by the students who used the PI materials is shown in Table 1. In addition to the numerical results shown in the table, there are numerous points of comparison and evaluation that were made and are discussed below.

TABLE 1

PENAL CODE

TEST SCORE DATA

Note that a different test was used in the 62nd OPD Academy. The tests are included in the Appendix of this report.

	Conventional Instruction	Programmed Instruction	Revised Programmed Instruction
OPD Academy	59th	61st	62nd
Number of students	20	28	26
Elapsed days of course	13	8	6
Lecture hours	25	3	3
Number of questions rejected	8	16	0
Highest score	91	90	97
Lowest score	60	55	72
Class average	78.8	78.4	87

The students using the PI materials achieved esentially the same class average as the earlier group and did so with 3 hours of lecture instead of 25, and approximately the same 20 hours of studying. There are only estimates of the number of student hours previously spent in studying for the Penal Code course, but anecdotal evidence indicates that no more time was spent with the PI materials even including the study hall hours which were poorly utilized.

Though the class average was the same, there was a slight increase in the spread of the grades in the group using the PI materials. Also, there were several more students having grades below the "passing" grade of 70. It is believed that these differences are due to some omissions in the topics covered by the PI materials and to certain problems with the test. Both of these issues are described more fully below.

The test shown in Appendix 1 has certain peculiarities of style that are unusual and require some getting used to. For example, true-false questions are presented in pairs and the student must first answer both questions and then combine the two answers to match one of the four possible multiple-choice options presented. 27 of the 49 questions are of this type. See questions 5 and 6 for examples. It would seem that when first confronted with this unusual method of halving the weight of each true-false item and of putting on a one for one guessing penalty, the student would be confused and do less well. Prior to the earlier administration of this particular examination, the students had been warmed up for the instructor's style by 25 hours of lecture and 3 mid-course quizzes prepared by him.

A further difficulty in analysing the results arises from the instructor's policy of disregarding those questions which are missed by more than 50% of the class. Based on an intention to be fair, this policy would be even better if it were used as an indicator of the shortcomings of either the instruction or the test. However, no record can be found of which 8 questions were disregarded in the earlier use of this test. 16 questions were missed by more than 50% of the students in the present trail and were disregarded in computing the class average. These were items:

> 2, 14, 15, 20, 21, 24, 25, 29, 31, 32, 37, 40, 42, 43, 45, and 49. Of these, ten covered topics which were intentionally or unintentionally omitted from the PI materials.

(The unintentional omissions are being corrected.) The six questions remaining are 15, 25, 31, 32, 40, and 42. Except for #15, these are difficult pairs of true-false questions.

The second half of item 25, for example, requires the student to notice that:

> "Paying a person who provides a woman for the purpose of engaging in sexual intercourse establishes the crime of pimping."

is a false statement because "receiving" rather than "paying" is needed to establish the action of pimping. The question could cover the same concept more clearly if the student were asked whether the payer or the receiver was the pimp.

It is difficult to establish a correct assignment of the cause of these rejections to either the PI materials or the test. However, the questions did indicate that strengthening the PI coverage of attempts and proximate cause would be helpful. This is being done.

While the results in Table 1 indicate success of the PI materials in helping students achieve the same class average in less time, this does not give a full picture of the real effectiveness of the PI materials because the PI materials and the test have different emphasis. Before having available the tool of educational objectives, teachers typically make up tests which penalize insufficient effort on home assignments and insufficient attention in class. The alternative approach, which is generally considered a better measure of the effectiveness of an educational activity, is to test whether the student has achieved the ability to do those things which he was to be taught to do. With the former emphasis, it is considered reasonable to hold the students responsible for any major item of information mentioned in a lecture. The latter approach would not allow such a test question unless "remembering in lecture" or "remembering that point" had been an objective of the course. A specific example in the present case is the following. The PI materials were to train the student to:

1. charge suspects in homicide cases with homicide and not to make a distinction between murder and manslaughter, nor the degrees of those crimes at the time of arrest.

2. investigate for the types of facts that would relate to establishing or disproving the elements of murder, manslaughter, and their various degrees.

In view of this objective, questions 16, 17, and perhaps 30, which ask the student to choose between the types of homicide and their degrees, test a capability which was not an objective and was not specifically taught by the PI materials. The content of those questions was however used for examples in the earlier course, so the students had a better chance to know the right answer even without an increased ability to make such distinctions in general.

Another problem with the test as a full measure of the PI materials was the lack of emphasis on those capabilities which were emphasized in the PI materials and in which the students might be expected to do better than those who had not had the PI materials. This applies to such topics as deciding which facts in a case establish particular elements of a crime, establishing the capacity to commit a crime, and establishing the mental element in crimes where criminal intent may not be inferred just from the commission of a prohibited act. Though the test called for the identification of crimes, a process which seems to include matching facts to elements as a necessary step toward a correct answer, this is really not an adequate test of the desired behavior. The evidence of this is that a large number of arrests for properly identified crimes do not lead to prosecution because the peace officer did not do an adequate job of identifying and then describing which facts he used to establish each element of the corpus delicti. It is hoped, but not yet proved, that the PI materials have provided the students with a better capability in these areas than was previously the case.

The PI materials as used in this trial did not cover riots, disturbing the peace and conspiracies, but these topics were involved in several of the test items. These shortcomings of the PI test have been remedied. Both the lack of familiarity with the instructor's testing methods and the fact that some topics were simply not covered in the existing version of the PI materials would account for the increased spread in the students' grades. This is because variability in the students' initial knowledge and general test-taking abilities would have a greater effect in this situation than will be the case when the coverage deficiencies of the PI materials are corrected and when a test more closely atuned to the defined behavioral objectives is used.

2.1.4.2 Second Validation Test of Penal Code Materials

The PI materials on the Penal Code were expanded following the first usage to cover those areas previously omitted but considered necessary by the subject matter expert who reviewed the results of the first trial. In the second validation test, the students again were given three hours of lecture and discussion. Twelve hours of supervised study hall time was provided in class and the students completed their studying as a home assignment. The elapsed time of the course was shortened to six days, so that it could be completed before the course on the laws of arrest was begun.

This schedule permitted only one week-end for slower students to catch-up and complete the lessons. However, the final examination on the Penal Code course was not held until a week later to allow additional study time, particularly for memorizing the elements of the crimes listed in the appendix of the course. During the intervening week, the students' time was occupied with the PI materials on the Laws of Arrest, Search and Seizure and with the beginning of the course on report writing.

The final examination on the Penal Code administered to this 62nd Recruit Academy is included in the Appendix of this report. A comparison of this test with that used in both the 59th (Control Group) and 61st (First Validation) indicates that the test is more intelligible, less tricky, and attempts to cover the same material with greater relevance to job performance.

It should be noted that none of the examinations contained in the Appendix to this report should be considered ideal examinations. Validation of the materials required use of existing test questions. It is strongly recommended that local agencies draft their own examinations by modifying the criterion tests contained in the PI texts to suit their own individual needs.

Scores on the final examination given to the 62nd Recruit School may be considered a better indication of the effectiveness of the PI materials than the earlier test described in Section 2.1.4.1 of this report. The grades of the recruits in the 62nd Academy are also shown in Table 1.

2.1.4.3 Effectiveness in Meeting Minimum Objectives

Among other requirements of the Oakland Police Department Recruit Academy, all recruit officers must achieve a passing score of 70% or better on the Penal Code final and for the recruit school as a whole. To date, no recruit has failed an examination on material offered through programmed instruction. Traditionally, the Penal Code course has been the most difficult course offered in the school. Two recruits in the 62nd Academy were terminated because of academic failure. However, the men passed the Penal Code final examination with scores of 72% and 78%, and failed as a result of performance in other aspects of the school. This limited evidence, observations of instructors in the academy, and the range of scores in the validation tests indicate that the PI materials effectively reduce the rate of academic failure. While the materials, supplemented by the informal assistance of an experienced officer, were found to satisfy the needs of all students, they also tended to minimize the difference in achievement between the most successful and least successful students. The orderly presentation of information in the programmed instruction texts tends to lower those barriers to learning which block students disadvantaged by poor academic backgrounds or a lack of refined study skills from achieving the minimum academic performance required by the Recruit School. The programmed instruction texts also identify and faciliatate individualized attention to specific learning problems of particular students before the moment of the final examination.

2.1.4.4 Validation Testing of the Laws of Arrest, Search and Seizure Course

After developmental testing, the course on the Laws of Arrest, Search and Seizure was used with the entire 62nd Recruit School class. The twenty-six hours of class time available for the course were devoted to ten hours of lecture and discussion, ten hours of supervised study hall, and six hours of role playing. Two examinations were given and are included in the Appendix of this report. The "quiz" covering the Laws of Arrest, Search and Seizure resulted in a class average of 89%. No official final examination is given in this course, but questions on the course were included in a general mid-term examination. Of the twelve questions pertaining to the course included on this mid-term, no student missed more than two. The class average was 93% on those 12 questions. These results indicate that the materials were successful with this group of students.

2.2 Programmed Instruction Materials Applications

2.2.1 Recruit Training Application

During the validation testing, most the time previously scheduled for each course was retained in the Recruit School schedule. This provided for the possibility that failure of the PI materials might necessitate a return to the conventional instructional approach in order to bring the recruits to the required level of proficiency in each course. As that did not become necessary, the bulk of class time was devoted to study hall sessions, in which the students worked informally and individually on the PI lessons. A police officer or instructor was present throughout these periods to answer questions and to discuss particular points with individual students.

This study hall arrangement was found to provide a number of important advantages, though the amount of time allotted was excessive and could be reduced in the future. Providing the students an opportunity to have directed, yet informal, discussions with a working officer enhanced the relevance of the course and provided teaching at an operational rather than academic level. Further, because the teacher must only relate police actions to the law, he has no need to prepare an academically-styled course. It was suggested that the instructors assume the attitudes about legal questions which they would ordinarily take when performing a police function. They were to answer questions, if possible, in terms of what they would do if faced with an actual incident. They were to research or seek legal advice on any questionable points and report back to the student. In this way, the artificiality of classroom training was reduced. Recruits were not expected to solve problems in the classroom which an experienced officer could not and need not solve on the street. Recruits also obtained practice in choosing a course of action in the absence of complete information.

The study hall environment enables students to talk in small groups with instructors and with each other. Students may pursue those aspects of the course which specially interest them and get help on any concepts that are bothering them. Since the PI materials call for active responses from the student, his inability to respond

correctly to just a few frames in succession signals that he has taken a wrong mental turn or missed a key concept. In the individualized format made possible by the PI, the student can stop when he needs help and get it. He can do so without disrupting the progress of others or the performance of a lecturer. Lecturers often feel that it is their role to present material to the whole class. Thus, in a conventional lecture course, the confused student is viewed as a nuisance for whom the lecturer does not have time to stop. Even the most skillful lecturer is frequently faced with the problem of ignoring individual problems or wasting the time of many students to help a few.

A most noticeable difference exists between individualized in truction in a study hall setting and a conventional lecture. On the one hand, lecturers often complain they do not have time to do justice to the subject, let along answer the questions of students who have particular problems. On the other hand, one finds a signle instructor able to provide individualized attention to 30 or more students. This neglected advantage of the one room schoolhouse allows the instructor to ensure that a student has fully grasped a point before the student proceeds to the next topic.

Lectures are particularly inefficient for presenting course content. A conventional text is a better way to present information. In the ideal learning situation, a skilled tutor engages in a continual dialogue with the student. PI materials are an attempt to package the advantages of a tutor at the cost of a text.

The distinct and important role of the lecture in training is to provide the students with a performance by a person possessing the skills they are trying to achieve. The lecturer should be presenting himself for scrutiny. Using the course content as a vehicle, the lecturer demonstrates how he behaves and thinks relative to the subject matter. Thus, the lecturer is most effective when telling case histories and least effective when reading from the notes he hopes to convert into a textbook.

It is important to retain some time in each course for a lecturer to present "war stories" about police work. As the lecturer is no longer viewed as responsible for presenting

the entire course content, he can select topics for his lectures that are most interesting, exciting, or illustrative. The atmosphere of the lectures can become more relaxed, and they can be successfully offered by persons previously considered to be poor showmen. Good lecturers have always been those individuals who measured their lectures by their personal performance. These are the lecturers who are willing to spend the time to tell a story that illustrates a point. All experienced police officers have anecdotes relating to police problems which derive from their own experience. Many can be good lecturers if they will abandon the attempt to be talking textbooks.

A few hours of lecture were retained in the Penal Code and Arrest, Search and Seizure courses to permit the recruits to hear and see a trained person address the same problems they must learn to handle themselves. Additional lecture time was devoted to guest lecturers, who provided a non-police view of the criminal justice system.

Both courses were also supplimented with role playing exercises. This excellent educational device is becoming increasingly widespread and should be of enormous benefit. The OPD has video taping equipment which is used to record, play back, and critique role playing incidents. Role playing is an excellent way to use the class time freed by the efficiency of the PI materials and is a good supplement to the courses on the Penal Code and on the Laws of Arrest, Search and Seizure.

During the course on the Laws of Arrest, Search and Seizure, two of the training films produced by the Los Angeles District Attorney's Office were shown and discussed. This series, which includes over 20 films, is an excellent and inexpensive source of dramatized incidents for analysis by the students. The films were not designed to elicit active student responses, but that defect can be remedied by stopping the film frequently to allow time for students to reach their own evaluations of specific incidents.

The PI texts on the law made available as a result of this program, free the instructor in a beginning peace officer training program from the need to lecture on all the specific points of course content. This reduces his preparation time. By replacing lecture and undirected home study with individualized, self-paced programmed instruction lessons, the student learns more easily and more quickly. The student time made available by these efficiencies should be devoted to enriching the course of study through more discussions, more guest

lectures, and more role playing exercises or to providing more time for other courses in the curriculum. Though the PI materials could be used exclusively for homework assignments, instructors are urged to try the supervised study hall approach. It gives them time to tutor individual students without wasting the time of the remainder of the class and provides the students with a chance to talk over the material as they are learning it. If used in this way, the PI materials allow the instructor to lecture about the proper application of the information instead of on the information itself. Thus, lectures are used to their best advantage to cover the vital and interesting aspect of how an experienced officer actually applies the law in specific cases.

Each instructor should review any PI text that he will use to find those points in which his department's policies or his own opinions differ from those presented by the authors. These points should be handled during lecture periods. For example, there are differences in policy concerning the adviseability of taking a drunk home rather than arresting him. Once the students learn the law from the PI text, they will readily understand local policies intended to provide police service meeting the needs of their community. Thus, it is hoped that a few specific comments by the instructor on policy and discretionary points will easily correct any differences between the views in the PI texts and those of any agency in California.

2.2.2 In-Service Training Applications

The self-study format of PI texts makes them particularly flexible for in-service training, where manpower shortages make it difficult to free men from their assignments for training purposes. A whole range of possibilities exist, ranging from unmonitored use of the PI materials for homestudy to their use in conjunction with a regular training course. Within the Oakland Police Department, a pilot program of in-service training during roll call, that did not require removing men from their regular assignments, was implemented, as described in the following departmental order.

OFFICE OF CHIEF OF POLICE
OAKLAND POLICE DEPARTMENT

SPECIAL ORDER NO. 1567

TO: All members, Bureau of Field Operations and Community Relations and Youth Division

DATE: 13 Apr 71

SUBJECT: Lineup Training in Criminal Law

EXPIRATION DATE: 6 Jun 71

I. General Information

For the past eight months, the Department has been involved in a federally-funded grant project to develop programmed instruction training materials on Criminal Law. Considerable effort has been expended to prepare study guides and course workbooks by Lieutenant Joseph Colletti of Preventive Services Division, in conjunction with educational specialists working under contract to the Department.

Seven programmed lessons and a test covering the entire Penal Code have been developed and are presently being used to streamline the teaching of this subject to inexperienced officers undergoing recruit training. The next step in the development and testing of the programmed instruction method is use of the materials for in-service refresher training of experienced officers.

II. Method of Conducting In-Service Training

During a seven week period beginning 19 Apr 71, sergeants and patrolmen of the Bureau of Field Operations and the Youth Section will be given self-instruction lessons on the Penal Code, to be completed during regular line-up training periods. Completion of the lessons will provide both a review and updating of personal knowledge of the Penal Code and an evaluation of the effectiveness of the materials and of programmed instruction as a method of in-service training.

Approximately forty officers will be selected at random and tested on their knowledge of the Penal Code before and after the programmed instruction lessons are administered to sergeants and patrolmen of these organizational units

in order to measure the value of the training program. Since the tests will be designed strictly as an evaluative tool of the training material, individual scores will be held in confidence.

III. Training Division Responsibilities

A member of the Training Division will attend all line-ups on 19, 20 and 21 Apr 71 to distribute self-instruction workbooks containing the first programmed lesson to all sergeants and patrolmen of the aforementioned organizational units, and to explain procedures for completing the workbooks and documenting time devoted to the project. The Training Division will provide organizational unit commanders with copies of the Penal Code to be used in conjunction with the lessons and Labor Distribution Cards to document time spent by participating members.

IV. Responsibilities of Participating Members

A. Completing Programmed Instruction Lessons

Specific instructions for using the programmed materials will be included as a part of the lessons or provided when the lessons are distributed. Each of the seven lessons which will be provided are designed for self-study to enable participants to work at their own speed. Students will be able to move quickly over topics with which they are familiar and to spend more time on new laws or legal points which are not frequently encountered on the job. The programmed lessons have been designed so that one lesson should be completed each week.

Because of the variance of line-up training time available for the project, members assigned to Patrol shall devote five one-quarter-hour line-up training sessions per week to programmed instruction. Members assigned to Traffic, Preventive Services and Youth Section shall devote three one-half-hour sessions per week to programmed instruction.

B. Labor Distribution Cards

1. Documentation of Time Spent

Each member who has been issued a programmed workbook will be given a pre-printed labor distribution card in duplicate on which will be shown his name, city employee number and other data. Participating members will sign each card on the line above the words "Submitted By." The actual number of hours

expended will be computed by the Training Division.

2. Absences from Line-up

If a member participating in the program is absent for any reason (e.g., O.T.A., illness, vacation) from line-up training sessions during the week for which the labor distribution card is provided, he shall sign both copies of that week's card on the line above the words "Submitted By" and shall also indicate on the same line the number of line-up training sessions he actually attended that week. The actual number of hours expended will be computed by the Training Division.

C. Responsibilities of Sergeants

Sergeants in attendance at line-ups shall distribute to each member the current week's programmed lesson and ensure that each member (including themselves) sign a labor distribution card in duplicate, to document time spent at line-up training during the previous week. Bureau of Field Operations sergeants will deposit the signed cards in a box provided for that purpose.

V. Organizational Unit Responsibilities

Organizational unit commanders will be responsible for distributing subsequent lessons and collecting labor distribution cards from members under their command.

A. Bureau of Field Operations Responsibilities

The Bureau of Field Operations commander shall ensure, on a weekly basis, that each sergeant and patrolman who was shown to be in an on-duty status by the daily watch detail signs a labor distribution card. The Bureau commander shall ensure that all signed time cards are forwarded to the Training Division within three days following completion of the preceeding week's lesson.

B. Youth Section Responsibilities

The Youth Section commanding officer shall ensure that all sergeants, patrolmen and policewomen under his command sign the labor distribution cards at the conclusion of each week's lesson. The commander shall ensure that all signed time cards are forwarded to the Training

Division within three days following completion of the preceeding week's lesson.

The materials may be retained after they have been completed for future reference or study, with the exception of the Penal Codes, which shall be returned to the Training Division by organizational unit commanders.

Questions regarding the program or critical comments after it has been completed should be directed to Lieutenant J. McArthur, Training Division.

By order of

C. R. Gain
Chief of Police

There was a wide variation in response to the pilot roll call training program using PI materials. Some watch commanders were energetic in seeing that the allotted 15 minutes were as free of interruptions as routine business would allow. Others were less co-operative with the program. Officers interested in study for promotional exams were eager students. Others thought that this training was a waste of their time. In this pilot program, there was no attempt to require the officers to complete the lessons or to concentrate on the task. The results of the pilot program were evaluated in two ways.

Twenty officers were given a pre-test on the Penal Code. At the end of the training program, a second exam covering the same material was administered. The two exams are included in the appendix to this report. Only 14 of the original 20 officers were available for the post-text. For this group of 14, the results were:

Pre-test average	71.4%
Post-test average	85.0%

This represents a gain in knowledge as measured by testing of 19%. No penalty for wrong answers was applied as a guessing factor. If that had been done, the improvement in test scores would have been greater. The pre-test average for the 20 officers taking that test was 73.3%. Sixteen officers took the post-test, including two who had not taken the pre-test. The 16 officers had an average score of 84.6% on the post-test. This mixed grouping showed a test score improvement of 15.5%.

A score improvement percentage is computed as:

$$\frac{100 \text{ X (Post-test score - Pre-test score)}}{\text{Pre-test score}}$$

For the 14 officers who took both tests, their improvements as computed with this formula were 4%, 5%, 6%, 8%, 8%, 9%, 16%, 19%, 26%, 29%, 31%, 34%, and 39%. The average of these gains is 18%. It should be noted that every member of the group showed some improvement and that some showed great change. In fact, seven men receiving the lowest grades on the pre-test had an average improvement of 26%. Three of

the men in the lower half of the class on the pre-test moved into the upper half on the post-test. These results indicate that the PI materials were particularly helpful to those needing the most help. A claim which cannot usually be made by conventional instructional techniques but which is common for PI materials. This is most appropriate for vocational training, where the organization wishes to ensure at least a specified level of competence on the part of every employee.

Since officers are best informed about laws involved in the cases they handle most frequently, these test scores do not correspond directly to the percentage of cases which an officer is prepared to handle properly. Still, it is felt that in a significant number of cases these officers will have a sounder grounding in the law as a starting point for proper police action.

An interesting feature of the errors made on the post-test was that they were almost entirely on material covered by the last 3 lessons of the PI text. On the pre-test the errors were more uniform over material on all topics. One might suppose that this was the result of the men having completed only the first 4 lessons but not the last 3. Such an occurrence could correspond to either a loss of interest or to the fact that insufficient time had been provided for studying during the 7 weeks of the roll call training program.

Depending upon the reason for the observed text results, it might be expected that the effectiveness of the program could be increased by either allowing more time than 7 weeks for the project or by providing some monitoring of progress as a stimulus for increased effort. Perhaps both would be useful. Merely, the administration and grading of pre- and post-tests would tend to motivate student efforts.

The second measure of the in-service training program was an opinion poll conducted by the Department's Training Division. The opinion questionaire is included in the appendix of this report. The results of the poll are presented in the Training Commander's letter which appears in section 1.2.6 of this report.

The pilot program using PI materials for in-service training was conducted with the lessons of the text on the Penal Code.

Though specifically developed to meet the needs of recruits, 77% of the experienced officers polled stated that they thought the level of the material was satisfactory. The level of the text on arrest, search, and seizure will probably be even more acceptable to experienced officers than the Penal Code course, because it contains a large number of realistic practice cases and deals with an area of practical importance which has undergone significant changes in recent years. The Arrest, Search and Seizure text will be used in a forthcoming in-service training program by the Oakland Police Department following the model of the pilot program on the Penal Code. The text on Dangerous Weapons Control Laws would also be suitable for such use. The course on Evidence is intended to provide an adequate orientation to the procedures of prosecution to enable the recruit to begin to perform as a peace officer. Once an officer has been involved in a trial, he may find this course too simple. The course contains a test on each chapter, which enables the student to determine whether he has mastered the contents of each chapter. Thus, an experienced officer could move quickly through the Evidence text without wasting time. But, of the four, the Evidence text has the least to offer the experienced officer.

As a result of the experience gained from the pilot program of in-service training, it appears that PI materials can be used effectively even during 15 minute sessions under the less the ideal study environment of the roll call period. Experienced officers, more than recruits, are able to handle the materials almost entirely on their own and have established channels for getting answers to legal questions that they may have. It is suggested that officers receiving such in-service training be given a pre-test and a post-test, primarily as a mechanism for showing official concern for their improvement. If the pre-test papers are collected and the students are not forewarned, there is no particular reason that the same questions cannot be used on both the pre- and post-tests (though different exams were used in this study).

2.3 Computer Assisted Instruction

2.3.1 Presentation of Instruction by Computer

In this project, the use of a computer as an automated tutor was investigated. Two modes of operation were tested. One is described in this section and one in section 2.3.3. In the first, the programmed instruction materials originally developed in written form were "programmed" into the computer for presentation to the student at a TV style terminal such as is shown in Figures 1 and 2. The material appears in written form on the screen and the student answers by typing his response on the keyboard of the terminal. The student's response is automatically compared to "correct" response and he is informed by printed message whether his response was correct or incorrect. Depending upon his answer, the next occurance will be either to move on to next portion of the course, to go back to an earlier part of the course, to receive a remedial comment before one of the first two options, or to be given another chance to make the correct response. These choices are pre-determined by the educational programmer when he prepares the PI materials for insertion into the computer.

In this project, the word "program" is used in two different ways. Instructional ma terials are "programmed" as described in earlier sections by developing a sequence of information presentation which requires active participation by the student. Such PI materials can be presented in the form of texts, films, or audiotapes. In the type of computer assisted instruction used in this project, the written PI materials are printed at a computer terminal each time a sutdent goes through the lesson. In order to control the operation of the computer, a computer program must be prepared by a computer programmer. The computer program consists of instructions which the computer executes in presenting the PI materials to the student. Both the computer program and the PI materials are stored in the computer memory.

Instructions on the use of the computer program used in this project for computer presentation of PI materials is described in the appended set of CAI Documents. That program can present any PI materials on any subject. The computer program

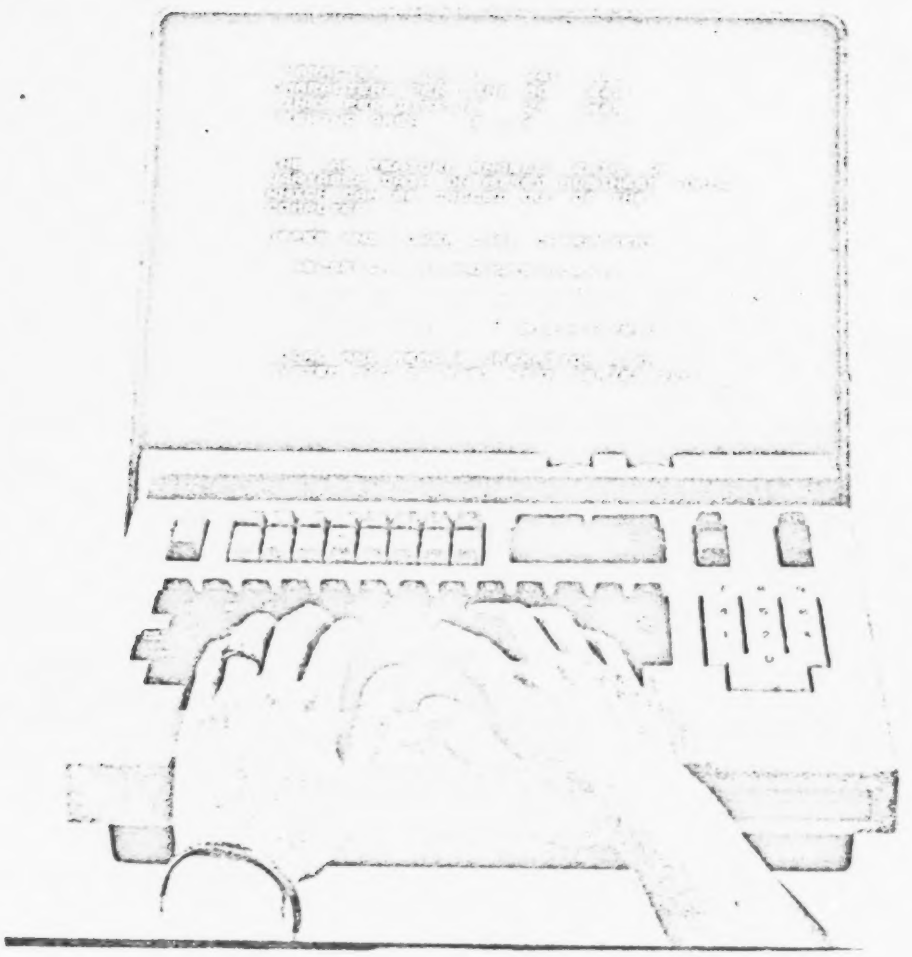

Figure 1 Photograph of a computer time sharing terminal. The Bunker-Ramo terminal pictured is typical of the type of terminal which will be used for this program.

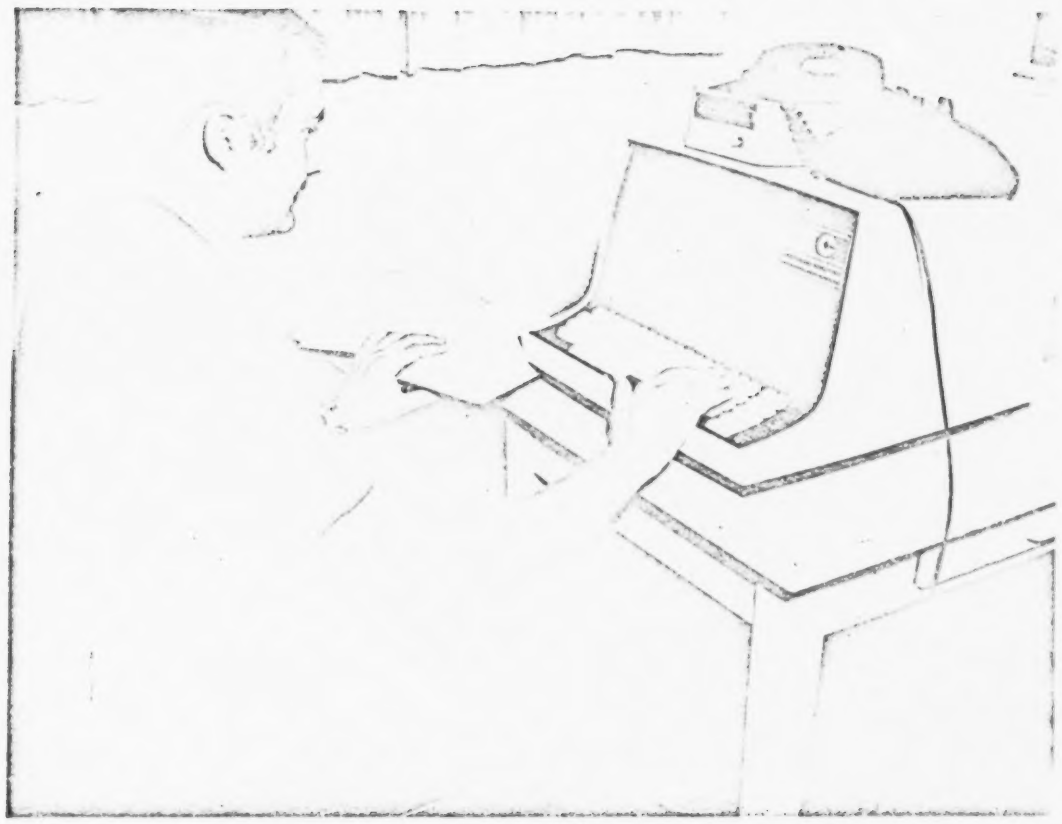

Figure 2 Photograph of a police officer engaged in computer assisted instruction at a computer terminal. The terminal communicates with the computer by audible beeps transmitted by ordinary telephone. The computer displays written messages on the television screen (see Figure 1) and the student responds by typing on the electrified keyboard. Operation of the terminal is silent. The student is shown referring to the Penal Code as instructed by a message from the computer.

is separate and distinct from the PI materials. To prepare printed PI materials for CAI, it is necessary to follow the instructions just mentioned. This is done by an educational technologist who makes educational decisions about the sequence of steps to be followed by the computer. The third lesson of the Penal Code course (covering Homocide) was prepared for computer presentation. It is shown in the form ready for storage in the computer memory in the appended set of computer documents. Each line of the course is identified by a two letter code which indicates to the computer the nature of the text on that line, such as a question or an answer. Once the educational technologist gets the PI materials into this form, following the instructions mentioned above, the PI material is keypunched and fed into the computer for storage.

Many of the responses required of the student in the PI materials are just short answer, such as "YES" or "TRUE" or a letter indicating the correct item on a multiple choice question. However, some of the educational objectives required could only be met by "constructed" responses, in which the student writes out his answer. Since the computer can only identify correct answers if they exactly match the answer originally specified by the educational technologist, a constructed response of "malicious and willful" would be marked wrong if the correct answer were "willful and malicious". Similarly, the computer would treat "willful and malicious" as a wrong answer.

The following innovation was used to circumvent this inherent limitation of CAI, in those cases which educationally called for constructed responses. The student was instructed to make his constructed response in writting on a piece of paper and then to indicate to the computer that he was finished answering by hitting the attention key on the terminal. At that point, the computer displayed the stored correct answer on the screen and asked the student if his answer were correct. Our experience with self-study PI materials indicates that students recognize that individualized study is not a test and can therefore be trusted to play fair in grading their own responses. In working with printed PI materials, the student grades all of his own responses. It therefore seemed reasonable to allow him to grade his own constructed responses in the CAI situation. After the student indicates

"YES" or "NO" to the question of whether his constructed response matches the stored correct answer, the computer proceeds by considering "YES" to be the correct answer to the original question and "NO" to be the wrong answer.

The above approach for handling constructed responses in CAI was found to work well. It eliminates both the difficulty of requiring the student to type out a long answer and the problem that arises because the computer cannot interpret answers (but only compares them, letter by letter, with a previously stored correct answer).

In the case of some concepts covered by the PI materials, the remedial steps to be taken if a student makes an incorrect response depend upon which wrong response is made. The computer program allows the educational programmer to specify different sequences of events for various, specific wrong answers. For example, if the correct answer for a multiple choice question is item "A", a different sequence of instruction can be specified for students who respond "B" from that specified for students who respond "C". While this elaboration is time consuming and not generally worthwhile, it is very helpful on occasion to assure that the student who makes an error is getting pertinent remediation that reduces his confusion.

The computer system used had the capability of writing on the terminal screen at the rates of 10 letters per second and 30 letters per second. These rates correspond roughly to 100 words per minute and 300 words per minute. At the slower speed, the time required to print the material on the screen, exceeds the time required by the student to read it. Originally, it was speculated that the slow writing speed might advantageously slow the student down, forcing him to concentrate on every word. However, it was found that the slow speed was distracting and irritating. Most students reread the material once it was on the screen and many paid no attention to the material until it was all written out. Thus, the time lag created by the slow writing speed was lost time, in addition to being an irritation. Therefore, after a few initial trials, all CAI work was done at the faster speed of 300 words per minute. The slow speed of 100 words per minute is a standard speed of teletype networks.

The computer operation for CAI is done on a time-shared basis, with the computer handling many users simultaneously. During heavy computer usage hours in the late morning and late afternoon, a student may have to wait a few seconds or longer before the computer proceeds with the next step in his course. To avoid delays, most CAI trials were conducted in the evening. Of the seven students who were subjects in this CAI trial, all but one spent an average of between 5 and 6 minutes per page of material (based on the page length of the original PI text). The one exception was a trial at 100 words per minute, during a day when response delays were particularly bad. In that trial, the subject averaged 8 minutes per page. On the other hand, students averaged between 2.5 and 4 minutes per page when working from the printed text. The difference in speed seems to be attributable to one or more of the following causes:

1. Waiting for the computer to proceed to the next step.

2. Waiting for the computer to write each segment of the course on the terminal screen.

3. Time spent in typing an answer on the keyboard rather than simply checking it off or saying it to yourself.

4. Possible distraction or confusion relating to the use of a computer and a terminal. The writing on the screen is light green on a dark greyish-green background, is entirely in capital letters, and is harder to read than a printed page.

It was found that officers quickly learned to use the terminal and were able to teach other officers to do so. An introduction to CAI was included in the course, so that the student could become familiar with CAI before starting on his lessons. The user instruction cards that were prepared are shown in Figure 3. It took 15 to 20 minutes for one officer to show the next officer how to handle the terminal and for that second officer to go through the introductory lesson on CAI.

The opinions of the officers about the computer presentation of PI material varied greatly. Some were excited by the novelty of dealing with a computer and some recognized that working with the printed texts was faster. Generally, the response to the computer did not seem significantly better

INSTRUCTIONS FOR USING THE COMPUTER TERMINAL
WHEN YOU ARE READY TO START

1. Set the terminal switches to ON and REMOTE. Turn the coupler switch on (so the red light is on).
2. Dial the computer (Oakland phone number is 835-3562) and set the phone in the coupler.
3. Watch for the flashing light to go on at the front of the coupler. If it does not go on, replace the phone and then repeat Step 2.
4. When the computer asks for user code type PAAC101 and hit the return key.
5. When the computer asks for the password type OPD and hit the return key.
6. At the next pause, type RUN TEACH/RCC and hit the return key.
7. If the computer asks DO YOU KNOW HOW I WORK? type YES (or 1) and hit the return key. (Note: Sometimes this step is skipped.)
8. When the computer asks for the course name type CHAP3/PAAC101 and hit the return key.

/ (See Step 6 and 8) is on the same key as ? (last key - bottom row)
1 is always number 1 - not the letter L as on the typewriter
O in OPD is letter O; in PAAC101 is the number zero

INSTRUCTIONS FOR USING THE COMPUTER TERMINAL
WHEN YOU ARE READY TO STOP

1. If you want to stop at a point where the computer asks if you want to continue or to stop, follow the instructions on the screen and you will get to the end of the lesson. Then go to Step 3.
2. If you want to stop in the middle of a lesson, type STOP as the answer to any question that requires a typed answer. Then go to Step 3.
3. After getting to a stopping point (either from Step 1 or from Step 2 or from the end of the course) type BYE and hit the return key. Be sure to note page number where you stopped.
4. After the computer has said goodbye and finished typing the time used, turn the terminal switch to OFF, turn the coupler switch off (the red light will go off), remove the phone from the coupler and place back on the phone base.

Special Reminders
Type 1 to answer true or yes -- type 0 (zero) to answer false or no
Type page number in following form..PAGE8..to skip to a certain page
Type STOP to get off the computer if you are not at a regular stopping point,

Figure 3. Two sides of the instruction card enabling the student to use the computer terminal on his own.

than to the printed PI materials, but this may not be significant in view of the small population tested with CAI.

The material presented by CAI was the same as that in the printed PI text. The major advantage that might have been expected was that the novelty and liveliness of computer presentation would hold the student's attention better than printed materials. This was not found to be the case. All the students tested found working with the computer tiring and frequently requested breaks. It also seemed that the ability to score one's own responses that is inherent in the PI text is more appealing and provides better motivation than the automatic scoring of responses done by the computer.

Another point, is that the student is able to look back in the text but is unable to "leaf through" the lesson at the computer terminal. Thus, the self-pacing and self-managing aspects of a PI text are somewhat reduced in CAI. The computer does not rush the student; he has an unlimited time to make each response. Still, because of the psychological pressure that the machine is "waiting" and the limitation of being unable to glance back at earlier pages, CAI diminishes the self-pacing advantages of PI. This seems to show up as decreased motivation on the part of the students, though again the sample population is too small for a really reliable conclusion on this point.

2.3.2 The Costs of CAI

The starting point for CAI is the preparation of PI materials, so the costs of CAI are always in addition to the costs of PI materials development. Then there is the cost for preparing the PI materials for computer presentation and, finally, the cost during actual student usage.

In the current project, the development of the PI materials cost about $1,000 per student hour of instruction; a figure which is at the low end of prevailing industry standards. Preparation of the PI material for computer presentation cost about $500 in addition. These are one time costs and could be amortized over a large number of students if CAI were used on a continuing basis.

Operating costs for each student involved:

1. Terminal rental at $140 per month

2. Telephone charges at $0.80 per hour for local calls, and multiples of that rate if a toll call is required to reach the computer.

3. Computer usage charges. On the commercial service used for this project, these were over $16 per hour. Charges varied with the time of day and with the student's speed. These charges consisted of $11 per hour minimum charge, plus about $5 or more per hour based on the number of operations performed by the computer. An estimate is given below of projected costs if an agency acquired a computer solely for use in CAI.

4. Other computer costs, consisting of storage charges if a commercial service is used or of operating personnel costs in the event an owned computer is used for CAI. The storage costs during this project were $240 per month for maintaining the course and program files in computer storage.

Thus, the cost per student hour of CAI during the project were in excess of $20 per hour. This figure is not representative of the costs which would actually be incurred if a small scale, time-shared computer were leased or purchased and dedicated to the CAI application. There are a variety of ways of providing the hardware for CAI and of financing such hardware. The following figures are representative of the approach which currently seems most desireable and which can be used as a planning model for other ways of accomplishing the same purpose.

The hardware required for a small CAI application might consist of the following items:

Hardware	Purchase Price
4 student terminals	$10,000
Mini-computer with 12K memory and a control terminal	23,000

Disk drive and 256K fixed disk	$15,000
Magnetic Tape Input/Output Capability	14,000
Software for computer system	5,000
	$67,000

Such a system could be leased on a one-year basis for 40% of the purchase price ($ and a one-year full maintenance and service contract would cost about $3,000. Thus, the cost per year would be about $30,000. If each of the 4 terminals were in use for 500 hours per year, the cost per student hour would be about $15. This figure is comparable to that obtained by using a commercial time-sharing service.

Economies can be achieved in a number of ways. Use of a longer term lease or of outright purchase of the hardware would reduce the yearly cost below 40% of the purchase price. If the equipment were purchased and used for 5 years, the cost would be about 30% per year including 20% for initial purchase and 10% for the cost of money. A larger system with more terminals would provide lower cost per terminal. A system with 16 terminals would cost about $110,000, lowering the purchase price from $16,750 per terminal on the 4 terminal system to $6,875 per terminal on the 16 terminal system. Finally, one might project more than 500 hours of usage per year for each terminal. In a large department or in a region containing a number of moderately big departments, just a few hours per man per hour could keep the terminals occupied for a major fraction of the 8,700 hours in a year. For example, if a 16 terminal system were purchased for $110,000 and charged at 30% per year plus $6,000 a service contract and if each terminal were used 1,500 hours per year, CAI could be provided at a cost of $1.63 per student hour. This would provide an availability of 139,000 terminal hours, of which it is assumed that 24,000 will be used. Thus, 8 hours of terminal time could be provided for each 3,000 men at a cost of $1.63 per student hour. If even larger systems were used or if fuller utilization of the terminals were possible, the costs could be reduced even further.

It is estimated that large user groups, such as public school systems, can obtain computer assisted instruction at less than the $0.80 per student hour that it generally costs for conventional public school education. In the police environment where 24 hour scheduling is imaginable, even lower projections are possible. These figures indicate that CAI costs can be made relatively minor compared to the salary paid the student in a vocational training setting, so long as there is a large enough group of students to make extensive use of the hardware and to offset the initial development costs. Thus, the question of whether to adopt CAI on a broad scale seems primarily answerable on the basis of its merits rather than its cost. From the current study, it appears that CAI offers no net advantage over printed PI materials for the presentation of instructional materials. The primary factors in this conclusion are the faster learning rates and better portability of the printed PI materials.

2.3.3 Computerized Diagnostic Testing

In the current project, the use of the automated grading and branching capabilities of CAI for diagnostic testing of students was investigated. A computer program was written to present test questions at the terminal, to compare student responses to correct answers stored in the computer memory, and to finally print out a score and the diagnostic messages which had been programmed for each test item that was missed. The computer program which was developed for this purpose is included in the appended volume of computer documents. An 18 item test on homicide was developed from the criterion test on lesson 3 of the Penal Code PI text. Each question was keyed to one or more pages of the PI study materials. Thus, for each question on the test which the student missed, the computer would write out a message indicating the pages of PI material that should be studied to correct the deficiency which caused the student to miss the test item. That test is also presented in the attached compilation of CAI documents.

A number of recruits and experienced officers took the 18 item test on homicide. Each student spending between 15 and 20 minutes at the terminal to complete the test. All of the test items were of the "objective" type, so a guessing penalty equal to the percentage missed is probably appropriate and will be referred to in the following discussion of the results. The test was taken by 3 newly hired recruits without prior police training. They achieved raw scores of 50%, 60%, and 65%. Applying a one for one guessing penalty, the adjusted

scores would be 0%, 20%, and 30%. Three experienced officers were given the test and achieved raw scores of 70%, 70%, and 75%. Again, applying the guessing penalty, these would be adjusted to 40%, 40%, and 50%. The recruit who scored 65% initially was retested after he had studied the first 3 lessons of the Penal Code text. At the second testing, his raw score was 90%. Applying the guessing penalty, his test grades improved from 30% to 80% (raw scores of 65% and 90%). Another recruit, who had not been pretested and whose only training was self-study from the Penal Code text while awaiting the start of the next recruit academy, scored 95% on the exam.

The above test results are interesting, but do not bear on the major issue of whether use of the computer as a testing machine has advantages over conventional testing procedures. Still, it should be noted that a diagnostic test has questions covering the initial concepts of the subject matter and the final application of all the information in the topic covered. Thus, in a diagnostic test on homocide, any citizen of sufficient knowledge to qualify as a police recruit could be expected to have enough information to make better than random guesses on many questions. At the other end of the scale, several quite difficult questions were included to diagnose any terminal confusion the student might have with the subject. Thus, it might be expected that experienced officers without recent training or exposure to homocide cases would miss a fair percentage of these harder questions.

The experience of using the computer as an aid in administering diagnostic tests seemed to indicate that the disadvantages of this approach outweigh the advantages for regular use in the police environment. The advantages are automatic grading and the novelty which might tend to impress officers with the sophistication and, by inference, the value of the training which they are to engage in after the diagnostic test is completed. Another potential advantage is that officers might be more likely to voluntarily test themselves if a computer terminal were continuously available to all. However, it is also possible that they will voluntarily make use of the criterion tests included in the PI texts, once these are in their hands. Of course, there is no evidence to believe that an officer who is attracted to a computer administered diagnostic test will carry out the study prescribed as a result of the test.

The students given the computerized diagnostic test covered the 18 test items in 15 to 20 minutes. The pre-test on the Penal Code was also administered to experienced officers and was of similar difficulty. It consisted of 37 items and occupied 30 to 40 minutes of student time. Though the population was quite small, it appears that computerized testing is about as fast as conventional testing. This is different from the rates for PI presentation, where CAI was slower than printed presentation. One possible explanation is that in computerized testing, the student was unable to go back to check his work. If students in fact spent about 25% of their time looking back over their answers on the printed test, the rates of completing test items would be comparable to the rates of completing instructional frames, with the faster rates being achieved with printed materials. The desireability of eliminating review of a test is difficult to decide because students are generally conditioned to checking over their answers. Also, it is a tenuous argument to say that not looking back is more analogous to actual job performance, in view of the many artifacts in the test environment.

All of the officers used as subjects for the computerized testing were attracted by the concept. One student commented that the fact that you could not go back to an earlier question to change an answer made the test a better measure of one's actual ability. This feature enables one to ask a sequence of questions of successive levels of difficulty to determine just where the student's ability lies, without having to avoid phrasing in one question that would prompt the correct answer to another question.

The disadvantages of computer administered tests are mainly questions of cost and convenience. It is more difficult to prepare a test for computer presentation and one is essentially forced to use only "objective" type questions. Where training materials, once programmed into the computer, will require only occasional and minor updating, test questions must be continually changed if the test is to continue to be useful to the users. Secondly, the amount of usage that can be projected for computerized testing will be significantly less than for CAI. Therefore, the economies expected from full utilization of computer hardware will not be realizable where the computer is used

solely as a testing machine.

The extra steps involved in putting a given examination on the computer and in arranging access to the terminal for the officers will in all but the largest departments, outweigh the effort needed to grade the exams and to prepare the study prescriptions manually. Computerized grading of answer sheets can be arranged economically, possibly through a local college or high school, eliminating the paperwork of grading even though the exam is presented in printed form. Also, the study prescription will more likely result in study if coupled with a little live exhortation and personalized advice on how to proceed.

The results of this trial usage of computerized diagnostic testing suggest that it should probably be considered a workable frill that could be used to dress-up an in-service training program. A short test on a single topic, such as homicide, might require 15 to 20 minutes of terminal time. In all but the largest departments, terminals could not be kept busy just for testing. Thus, the costs would be $10 to $15 per terminal hour or $2.50 to $3.75 per student tested on a single topic. Since one might want to have each student tested on a number of topics, the computer costs would make computerized testing expensive without achieving sufficient offsetting benefits to justify the cost. Therefore, the computer presentation of examinations seems impractical for the police training environment. Computerized grading of exams, on the other hand, can generally be obtained very inexpensively and should be considered whenever the number of students being tested exceeds 50.

3. Financial Note

Financial reports on the project will be submitted separately by financial officers of the City of Oakland. The project was completed within the estimated budget.

Appendix

None of the test instruments included in this appendix are recommended for use. They were designed to parallel previously administered tests, so that comparisons could be made between students using the PI materials and those who had previously received conventional instruction. It is recommended that instructors prepare their own tests, using the criterion tests included in the PI texts for guidance.